

# Improvements to the ACATS Lidar and Development of a NASA Field Campaign Concept

Completed Technology Project (2016 - 2017)



## Project Introduction

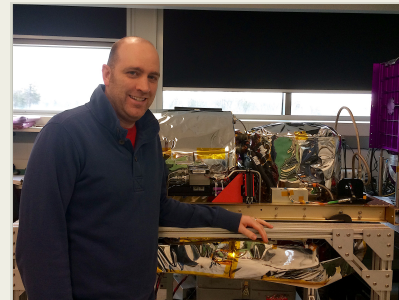
Vertical profile measurements of clouds and aerosols (dust, smoke, man-made pollution) from laser remote sensing instruments, such as the Airborne Cloud-Aerosol Transport System (ACATS) managed at NASA Goddard Space Flight Center (GSFC), are desired to study the interaction of clouds and aerosols and their influence on the climate system. This project consists of the installation of a new ACATS calibration device and mechanical modifications to the ACATS receiver subsystem. These modifications will result in more accurate measurements from the instrument. In addition, this project includes preparations for GSFC-lead field campaign to study the influence of aerosols on clouds and radiation that will include ACATS as a payload on a NASA aircraft.

Clouds and aerosols can have numerous effects on the atmospheric radiation budget. Ice clouds cause a warming effect, while water clouds can result in a cooling effect. During cloud-free conditions, aerosols such as desert dust and smoke from biomass burning can induce a change in radiative forcing at a magnitude comparable to that of greenhouse gases but opposite the sign. Additionally, aerosol can interact with clouds, changing the radiative effects on the atmosphere. These cloud and aerosol effects on the atmospheric radiation budget remain a major uncertainty in understanding and predicting the climate system.

Direct measurements of extinction vertical profiles from high spectral resolution lidars (HSRLs), such as the Airborne Cloud-Aerosol Transport System (ACATS) managed at NASA Goddard Space Flight Center (GSFC), are desired to study the interaction of clouds and aerosols and their influence on the climate system. Previous flights aboard a NASA high-altitude aircraft have demonstrated the ability of ACATS to provide direct measurements of extinction for short flight segments. However, the performance of the instrument is impeded by poor instrument calibration. This project includes modifications to the receiver subsystem that enable implementation and testing of a calibration device for improved results.

This project also supports the development of a field campaign to study the influence of aerosols on clouds and radiation. The field campaign will include the ACATS instrument and several other earth science instruments that fly on NASA aircrafts, as well as a management team that primarily consists of NASA and NOAA personnel.

The objectives of this project are as follows:



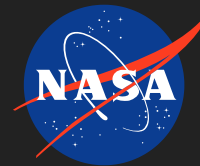
Project Lead with ACATS instrument during lab testing at NASA GSFC.

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1. Improve the ACATS instrument calibration and overall functionality of the receiver subsystem.
2. Ensure the ACATS instrument is ready for future flights on NASA aircraft.
3. Develop the science goals and aircraft configurations for the field campaign proposal that includes the ACATS instrument and several other earth science instruments.

The overall goal of this project is to have ACATS ready to participate in future field campaigns and develop the field campaign concept that will include ACATS. The tasks that will be completed to achieve the objectives of project are as follows:

1. Integrate and test the new calibration device (filters, diffusers, and servo actuator assemblies) with the current receiver optics (Objective #1).
2. Oversee the design and installation of a new receiver enclosure that is both durable and meets thermal and mechanical requirements (Objective #1).
3. Test the modified system both in the lab at GSFC and on a NASA aircraft (Objective #2).
4. Develop the science goals and aircraft configurations for the field campaign proposal (Objective #3).

## Anticipated Benefits

The ACATS instrument, once these modifications have been made, can be to participate in future aircraft field campaigns that contribute to NASA's Climate, Atmospheric Composition, and Weather Earth Science Focus Areas. In addition, the technology development in this project can inform future NASA spaced-based mission development in regards to lidar technology capabilities.

## Organizational Responsibility

### Responsible Mission Directorate:

Mission Support Directorate (MSD)

### Lead Center / Facility:

Goddard Space Flight Center (GSFC)

### Responsible Program:

Center Independent Research & Development: GSFC IRAD

## Project Management

### Program Manager:

Peter M Hughes

### Project Managers:

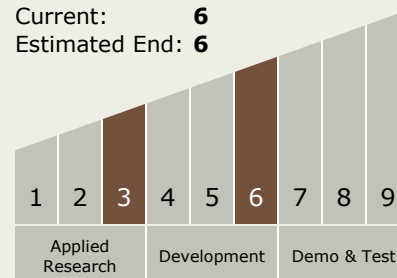
Matthew J McGill  
William E Cutlip

### Principal Investigator:

John Yorks

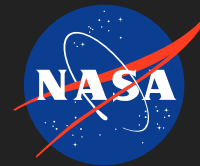
## Technology Maturity (TRL)

Start: 3  
Current: 6  
Estimated End: 6

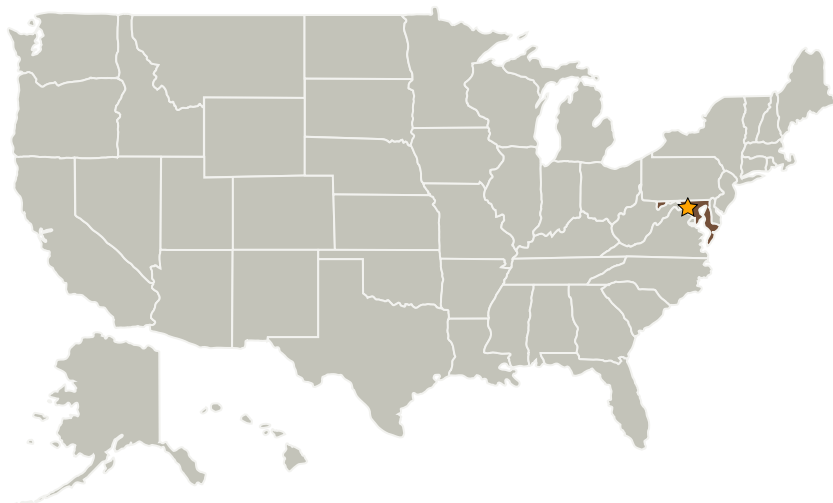


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## Primary U.S. Work Locations and Key Partners



## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - └ TX08.1 Remote Sensing Instruments/Sensors
    - └ TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves

## Target Destination

Earth

Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

## Primary U.S. Work Locations

Maryland

## Project Transitions

 **October 2016:** Project Start

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## ✓ September 2017: Closed out

**Closeout Summary:** The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services. Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry. The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies. If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. <http://techport.nasa.gov/help>

## Images



### ACATS instrument

Project Lead with ACATS instrument during lab testing at NASA GSFC.

(<https://techport.nasa.gov/image/26024>)

## Stories

The Airborne Cloud–Aerosol Transport System: Overview and Description of the Instrument and Retrieval Algorithms (<https://techport.nasa.gov/file/34331>)

### Project Website:

<http://sciences.gsfc.nasa.gov/sed/>